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Tomato Response to Soil Application of Boron and Potassium

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Abstract

Fresh market tomato production has a high demand for potassium (K) and may be responsive to the micronutrient boron (B). An excellent Iowa yield of 1,000 cwt/acre will remove 240 lb of K20/acre in the fruit alone. Thus, growers apply high rates of K20 fertilizer to achieve top yields and quality. Iowa research and soil surveys over the years have shown no need for B additions for corn,soybean, and alfalfa production (Dr. Randy Killorn, personal communication). However, our vegetable K research trials have shown low B leaf levels early in the growing season, 27 to 42 ppm. Tomato leaf sufficiency ranges vary from 20 to 75 ppm, depending on the region where the research was conducted and the crop stage of growth at the time of sampling.

Keywords

Horticulture

Disciplines

Agricultural Science | Agriculture | Horticulture

Tomato Response to Soil Application of Boron and Potassium

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Introduction

Fresh market tomato production has a high demand for potassium (K) and may be responsive to the micronutrient boron (B). An excellent Iowa yield of 1,000 cwt/acre will remove 240 lb of K_20/acre in the fruit alone. Thus, growers apply high rates of K_20 fertilizer to achieve top yields and quality. Iowa research and soil surveys over the years have shown no need for B additions for corn, soybean, and alfalfa production (Dr. Randy Killorn, personal communication). However, our vegetable K research trials have shown low B leaf levels early in the growing season, 27 to 42 ppm. Tomato leaf sufficiency ranges vary from 20 to 75 ppm, depending on the region where the research was conducted and the crop stage of growth at the time of sampling. Generally, at first flower or early bloom, the critical value is 25 to 35 ppm in the most recent fully developed leaf. Later in the growing season, after soil organic matter mineralization rates are near maximum, leaf B levels were more than adequate, 50 to 60 ppm. Because of the role of B in flower production and fruit set there may be a transient B deficiency at the time of rapid flowering for modern determinate tomato varieties. Our objective was two-fold: 1) to determine the effect of soil and foliar applied B on early marketable yield of fresh market tomatoes when grown with high soil K applications; and 2) to elucidate B effect on flower production and fruit set.

Materials and Methods

Planting. The site is a central Iowa prairie loam soil with a pH of 6.7, P of 87 ppm (v. high), exchangeable K of 108 ppm (low), B of 0.58 ppm (low), and organic matter of 2.36%. Mountain Spring tomato transplants were set May 16, 2006.

Plot Design. A split-plot, randomized complete block design with four replications. Potassium rate (0 and 400 lbs K_2O/acre) was the main plot treatment and B method of application (0, 3 lb B soil application as Solubor, 0.5 lb/acre B as foliar, sprayed to run-off, and soil + foliar application) the subunit treatment. The soil application along with the herbicide was rotovated in prior to laying the plastic mulch. Foliar application was June 6 at initial flower cluster appearance. Each treatment plot consisted of three rows with data collection from the center row. All plants were staked and tied according to Florida-weave system.

Fertility and Irrigation. N and P_2O_5 at 75 lb/acre were broadcast and disked in. Zn at 4 lb/acre was applied with the herbicide. Soil was rotovated followed by black plastic and Drip In trickle irrigation were installed. Irrigation management was via tensiometers.

Pest Control. Treflan pre-plant was incorporated for weed control and Kocide and Quadris fungicides were used for disease control. No insecticides were applied.

Harvest. First harvest was July 24 and continued weekly until August 21 for five harvests. Ripe fruit were sorted into marketable and cull categories. Cull fruit included rots, radial and concentric cracks, very small fruit, and fruit with ripening disorders. The marketable category was further divided by size: extra large, large, medium, and small.

Results and Discussion

The potash application reduced leaf B levels as has been noted in previous research (Table 1). However, there was no K rate by B treatment interactions. Soil B application ($P < 0.05$) increased leaf and blossom B concentration, but this enhancement did not result in a greater number of flowers produced or an increase in the fruit set percentage (Table 1). The control leaf B concentration of 30 ppm would be considered borderline deficient. The foliar application was not effective in elevating B concentration in either leaves or blossoms. The leaf and flower samples were taken June 27 or three weeks foliar B application. The overall fruit set percentage of 75 to 85% is very high and undoubtedly B concentration was ample for flower production and fruit set.

Fruit yield was not affected by B treatment at any harvest date. For total seasonal yield the cull percentage was reduced by K fertilization and the quantity of large size fruit increased (Table 2). Extra large and large category fruit accounted for 98.3% of total marketable fruit harvested. The reduction in cull fruit by K fertilization was mainly the result of decreasing the incidence of blotchy ripening.

Thus, boosting leaf and flower B concentration early in the growing season did not influence tomato yield or quality. If a grower believes B would be necessary then the recommendation is for 1 lb B per acre (either as Solubor or Borax) at the pre-bloom stage applied through the trickle irrigation system.

Table 1. Leaf and blossom elemental analysis, three weeks after initial flowering June 27, 2007.

Treatment	Leaf concentration, %		Blossom concentration		Flower number	Fruit set, %
K_20 rate, lbs/acre	B	K	B	K		
0	39.1	3.14	47.8	2.54	na	na
400	34.3	3.36	44.5	2.63	na	na
Significance[1], $>F_{.05}$	*	ns	ns	ns		
S.E. mean	3.1	na	na	na		
B rate						
Control, 0	30.4	3.21	38.1	2.58	14.8	75.9
Soil, 3 lb/acre	42.6	3.28	52.5	2.56	14.4	80.9
Foliar, 0.5 lb/acre	28.0	3.34	38.9	2.66	13.9	81.5
Soil + Foliar	45.9	3.17	55.1	2.54	14.4	79.1
Significance, $>F_{.05}$	*	ns	*	ns	ns	ns
S.E. mean	3.1	na	4.6	na	na	na

[1] * = comparison is different at the 5% level

Table 2. Seasonal yield, as cwt/acre, of Mountain Spring tomato, harvested from July 25 to August 21, 2006.

Treatment	Marketable	Cull	Cull, %	Total season yield
K_20 rate, lb/acre				
0	372	204	35.4	576
400	423	163	27.8	586
Significance [1], $>F_{.05}$	ns	**	**	ns
B rate				
Control, 0	370	192	34.2	562
Soil, 3 lb/acre	400	186	31.7	586
Foliar, 0.5 lb/acre	403	199	33.1	602
Soil + Foliar	417	159	27.6	576
Significance, $>F_{.05}$	ns	ns	ns	ns

[1] * = comparison is different at the 5% level.